

Hot Iron

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Issue 76

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The Walford Electronics website is also at
www.walfordelectronics.co.uk

Kit Developments

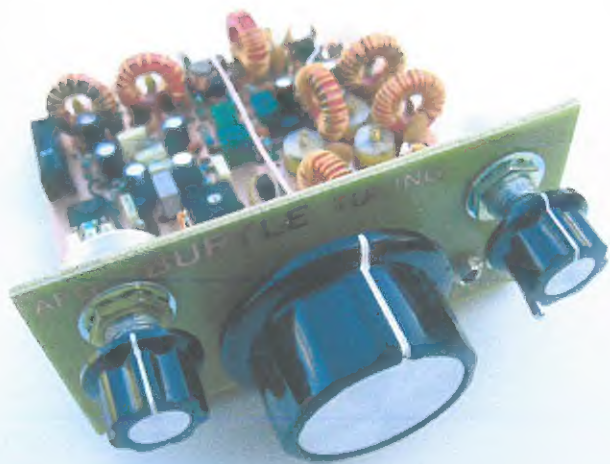
The **Bridgwater** and **Burnham** are now available with encouraging reports from early customers.

I also have my prototype **Burtle** (right) working well on 40m. It is a specialist CW TCVR for any band 20 - 40m with a DC RX with narrow bandpass audio filters, proper crystal mixing VFO, full break in and an output of 1.5W. In principle it should also be possible to use it on any of the other bands 10 - 160m but I will not be trying all of them - just too many options to try out! I could do with some early builders if anybody would like to try one. It is pretty dense and is definitely in the advanced category. Not fully priced yet but about £55. Tim

Editorial

Phew - what a spring this is turning out to be! Glorious weather for most of March and then incessant rain during the last half of April. We got our cattle out in the good weather but the rain and consequent field flooding seriously disturbed them and they are nearly all back inside again on winter type rations! The grazing pastures have been under 3 ft of water and the Environment Agency expect it will take a further two weeks before water levels are back to normal. Meanwhile all the grass that has been flooded has an unpalatable earthy slime all over it! Who would go farming? Me!!

In between I have been mulling over the possible schemes for the Minster Mk3! I am pretty sure of its block diagram now and would like to utilise a strong first mixer similar to the commercial Mini Circuits SBL1 types. They are a bit pricey even in quantity but do indicate a target to aim for! Luckily there are some alternatives that hold out good promise - see later! I would like the Minster in its simplest single band form to utilise the same frequency scheme as the Bridgwater; with a VFO driving a buffer/doubler that makes a single kit possible for any band 20 - 80m. The current challenge is to develop an easy doubler for the strong mixer. I would like some feedback about extra bands. Watch out for news and maybe an early sighting of a Minster Mk 3 at QRPiC 2012! Tim G3PCJ.



Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £8 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics—is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

More Fun in Far Flung Places by Dave Buddery Jnr

The remote area job came to fruition and I was in the thick of it. I had found out that the radio telemetry system ran on a single frequency around 220 MHz, just HF of the old USA 1.5 metre band. This was a problem because in our ITU Zone, this part of the spectrum was not scheduled for commercial radio telemetry purposes. I thought about it for a couple of days and decided to go over to the local commercial HF / VHF radio supplier and sound them out. We went right around the whole problem, and one of them had a REALLY good idea. He said, "Why don't you get yourself up there with a spectrum analyser and a portable antenna?"

We made the arrangements; collected the unit, with a portable antenna, and flew down, and got to rather covert work. To cut a long story short, there was a very powerful telemetry transmitter about 15 MHz LF of our frequency (it was military – I did a very low profile DF job on it and located it at a big military camp about 50 Km away). I went back to town with a plan in my mind. The firm's lawyers said that going out with a spectrum analyser to check frequency occupation was a bit naughty, but probably not actually illegal, however they were concerned about my DFing the military transmitter and advised silence on that aspect! I was overdue to go and see the Ministry, so I had a final run-through of our presentation with the local MD and we agreed to present the whole thing as a request for a temporary exemption and license for use of that part of the spectrum, should it be available. My little exercise with the spectrum analyser would be kept up our sleeve just in case we needed it.

We booked an appointment. The frequency spectrum and licensing guys looked at the paperwork regarding our system and said the inevitable, that our request was not in compliance with the ITU frequency allocations. We countered with the suggestion that no-one was using the bandwidth in the area and we needed only a temporary license for 6 months. I then dangled the bait – 70 or so units, individually licensed! That was a lot of money and we were going to have to pay 2 annual fees as the license fee re-set at New Year and the job would run over into the following year. The ministry guys told us they would be in touch within a couple of weeks and we departed. We seemed to be off to a fair start.

The ministry called us over and said that they viewed our application generally favourably but they were worried about frequency occupation in that part of the spectrum. I said that they ought to know about all the civil utilisation and that we were well clear of the aviation band etc. They looked a little uncomfortable and said "perhaps there is official use of that part of the spectrum". So I looked at them and said "such as the military?" So I let on a bit about going up there with the spectrum analyser and showed the results including a map of the area etc. They stared at me amazed. The senior one said "We were going to suggest something like this and you have done it already!" They looked over all my stuff (the DF matter was not referenced in the paperwork) and said we would be hearing from them shortly. We left feeling somewhat cheered. Four days later we got a call from the Ministry and they told us that we would get our licenses and to expect the official letter. This arrived and I got on with the mountain of ensuing paperwork. The MD was delighted as were our client and I got a bonus for sorting it out. I took the guys from the radio company out for a curry and beers, the least I could do under the circumstances.

I think a lot of the generally favourable treatment we got from the ministry on this occasion may partly have been down to my membership of the radio club and the fact that the word had got around about this CW operator who was suddenly working all kinds of stuff on 7 and 3.5 MHz CW – the locals were not much into DXing on the lower bands and it had caused a bit of a stir of the right sort. Of course the Company got all this "for free" as nowhere did it appear in my job description. But the Company had woken up to what the likes of us can do given the opportunity. (Dave - sorry I had to edit this so heavily to make it fit the available space. Tim)

Dipole Dilemma by Andrew Atkinson G4CWX

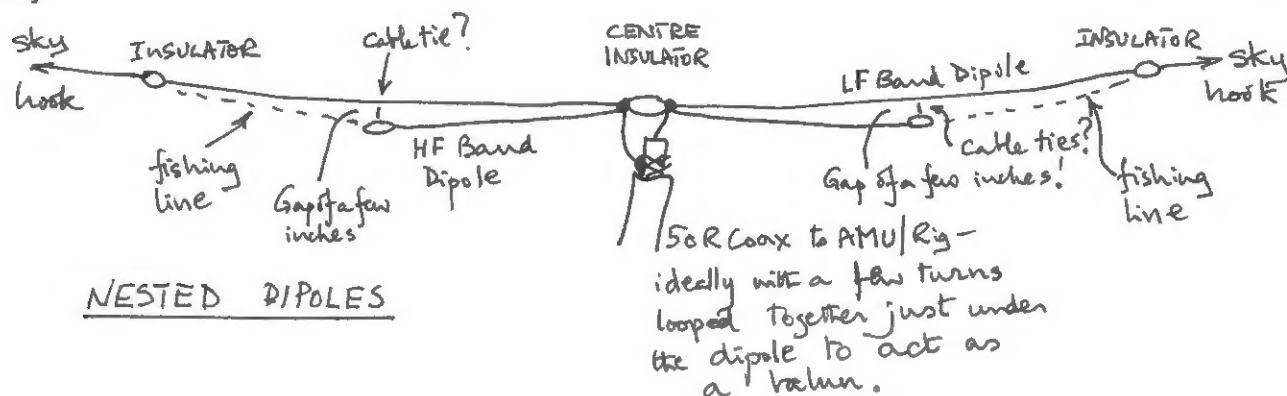
Last year saw me experimenting with one aerial after another. It took a long time to find something that was within budget and which would fit comfortably in my back garden. The end result was suggested by G3OOU and takes the shape of a standard centre-fed dipole with the ends dangling down at right angles. I was so impressed with the results that this aerial achieved I decided to give up on further experimentation and concentrate on a bit of operating for once.

The story thus far is a happy one – except that I was foolish enough to use sub-standard cable for the long arms of the dipole. Needless to say that after a fairly short period of time the rain and high winds wreaked their revenge and I was left with no aerial. Examining the cable carefully, I found that water or moisture had entered the sheathing of the cable close to the “T” connector. Over time this had caused the inner copper strands to deteriorate and eventually fail.

There was only one thing for it, and that was to replace the faulty cable, but this time do a better job of constructing it. I opted for the highest specification of Flexweave cable that I could lay my hands on. A word of caution here: make sure that you buy the genuine article and not “Flexweave Style” cable which is a truly inferior product. I cut it to length and then attached Crimp connectors to the ends. These were duly bolted to the “T” piece and the ladder line. I reasoned that there were two things that I could do at this point to increase the lifetime of the aerial. The first was to ensure that neither water nor moisture entered the cable and the second was to provide a modicum of strain relief for the dipole either side of the central connector.

The ingress of moisture was simply solved by applying five coats of Plasti-Dip. This is a liquid rubber-like goo which never truly hardens, but provides a watertight seal around everything it comes into contact with. I bought a small tin of this stuff a few years back and still have nearly half of it left over. I believe that the current price is about £7.00 per tin and is available from www.plastidip.co.uk. The final task was to provide strain relief for the central connections. I achieved this by using 24" pieces of Kevlar guy rope attached to each leg of the dipole with a series of cable ties (See Figure 2). Before hauling the repaired aerial back up to its rightful height, I gave it a good test by subjecting the central joint to a 75Kgs weight. It passed with flying colours. The aerial has now been in operation for almost a year and has coped admirably with everything that the dreadful weather in this neck of the woods can throw at it. I now feel a lot more confident every time I hear that storm force winds are on their way to us.

Note from G3PCJ. My ‘Raw Material’ file for Hot Iron seems to have been corrupted - maybe penetrating damp! I have a picture from Andrew of a nested dipole but can't find any accompanying text! I rather like the nested dipole approach as it can allow operation on several bands and often without an AMU. It comprises a number - often up to four - dipoles connected directly in parallel on the end of the coax feeder. The dipoles are cut for their normal (individual) lengths and arranged to be spread slightly apart from each other - this is the slightly more difficult bit! The longest dipole is hung up as normal. The next longest can be supported from the longest, but it will tend to distort the first, so it is better to extend the shorter ones with non-conducting rope/ fishing line etc and support them from the same sky-hooks as the long one. You might find that an occasional cable tie keeps them looking tidy. At their centre, join them in parallel to the coax! Easy.



Some voltage regulator thoughts - by Peter Thornton G6NGR

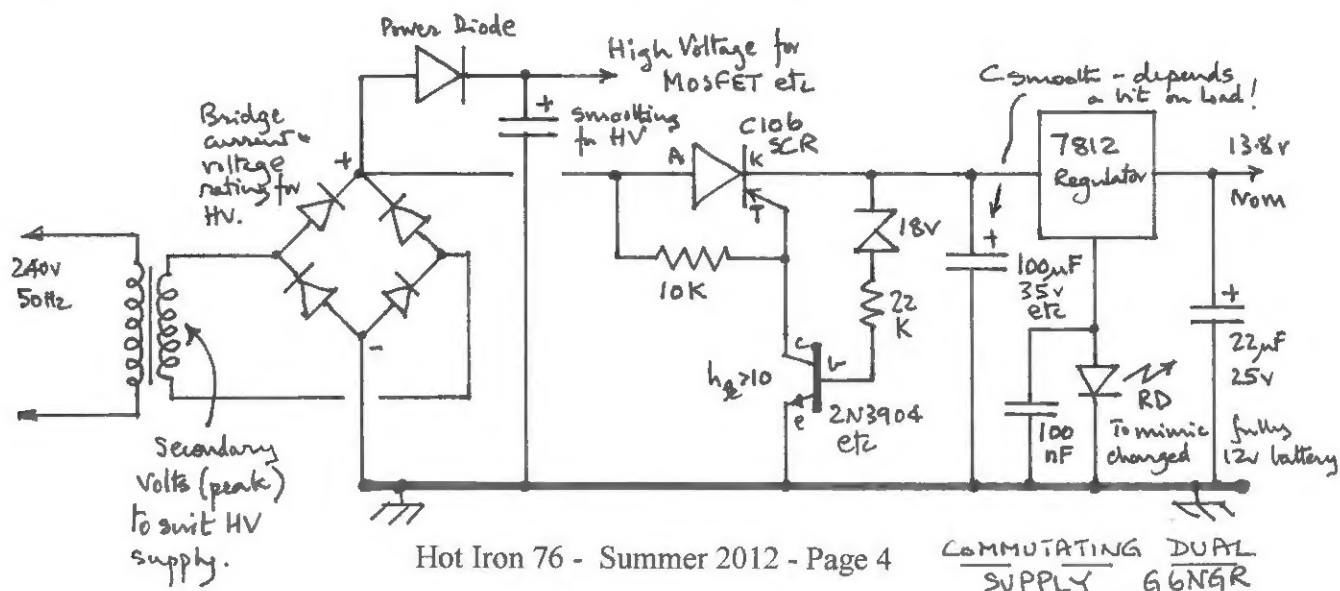
Here's a thought: you want to run a MOSFET PA at +24v [or more] for decent linearity, yet need +12v for the rest of the rig. How to do it with just one power supply and little waste? You could use a dropper resistor from the high voltage; or a linear regulator; or even [may the good Lord forgive you] - a "switched mode wide band interference generator power supply".

I often use a 7805 to run an SA 602 double balanced mixer. For a DSB transceiver design I want my '602 supply near maximum to get the most output. This means +7v. on pin 8 of my SA 602; not a "78XX?" family regulator value. I fit an LED in the common lead, which is normally to 0v, but instead lifts it by the on-voltage of the LED, normally 1.8v. - 2.0v. Thus my 7805's 5v + 1.8v = 6.8v! I parallel the L.E.D. with a 100nF, 50v ceramic capacitor to reduce noise. A 7805 regulator typically runs a couple of milliamps to ground via the common terminal - so my booster L.E.D. lights nicely when my '602 is powered up [on transmit, for instance]. There's my power indicator lamp: and it's not cost me a single extra milliamp from my power supply!

Let's say we're trying a homebrew IRF 510 linear for our DSB transceiver, we're wanting +36v on the drain. How do I reduce +36v to +12v for the rest of the rig? You could use a linear "7812" regulator, but if your rig pulls 500mA, the 7812 will be dropping 36v - 12v = 24v; at 500mA, that's 12 watts. You need a chunky heatsink, just to throw away that 12 watts.

An almost unknown [nowadays] power supply fills the gap between a "linear" and a "SMPS" - a "commutating" supply. They use an SCR - yes, on DC - to pre-regulate, and a light-weight linear regulator to put the final "polish" on the output volts. The circuit runs "zero crossing" so there's no switching "hash" from the SCR. The commutator comprised an SCR, two resistors, and NPN switching transistor and a zener diode. Done. That's it. No watts wasted, the SCR switches automatically, feeding the light-weight regulator with just enough voltage to keep it running sweetly.

Here's how it works. Imagine the smoothing capacitor is discharged. The zener does not conduct; there's no voltage on the smoothing capacitor to break it down. The transistor is "off". The resistor from the SCR anode to the gate feeds current into the gate the moment the full wave rectified half cycle begins to rise from zero - the SCR turns "on", and feeds the full half cycle into the smoothing capacitor, shutting off as the half cycle voltage falls once more to zero. After a cycle or two the capacitor is charged, and the zener breaks over, feeding base current into the transistor. This turns the transistor "on", which shunts to negative the gate current - so the SCR does not turn on. Only when the voltage on the smoothing capacitor falls below the zener voltage and the transistor shuts off, is gate current allowed to the SCR, which turns "on" and tops up the smoothing capacitor once again. The current is fed in half cycles as and when the load demands it - on low current, the transformer "pings" every now and then; under increasing load, the transformer feeds more and more half cycles into the smoothing capacitor, resulting in a curious "bumbling burbling" noise from the transformer. Since the feed to the SCR is full wave rectified, a negative cycle will power the load just as often as a positive, so no dc is introduced into the transformer secondary. Note the power diode feeding the MOSFET circuit: this isolates the "hit n' miss" nature of the commutator from the MOSFET supply. A very small price to pay for such an efficient system.



Ham Radio Revisited! By Colin Wood DD5CF

Having come back to Ham radio after a break of about 13 years I was amazed at the amount of progress and that someone like me can now be active on HF without having passed a morse test! My budget was limited so kits were an obvious answer. I find electronic theory very confusing so the prospect of building a kit was a bit daunting! My first kit was The Brendon for 80m and I was glad to see the very precise step by step building instructions but even with these, I had a couple of problems that were soon resolved.

I have since built Tim's AMU, The Fivehead 40m, frequency counter and Audio extras, all kits are working well and the amount of emails I had to send were reduced with each kit. I have had lot of compliments on the audio of The Fivehead, the kits are used both at home (2 watts) and when portable (1.5 watts), at home I have used a home made full size horizontal G5RV folded into two U shapes to fit in a L shaped attic space, each part of the attic is about 7 meters long and about 1.5 meters wide so the G5RV just fits in with the apex pointing west, it has a 450ohm ladder line feeder directly into the AMU, and I have also tried a ZS6BKW ant which is a modified G5RV so it is resonant on 40m /20/10 with good results, I now use a home made $\frac{1}{2}$ wave dipole for 40m which fits inside the attic with no folding needed, I am also at the moment trying out G7FEK's 80m limited space antenna which I am able to hang outside, the SWR is within the range of the building instructions but I have not had a QSO on 80m with it yet.

When portable I have used another home made G5RV, hanging from any 3 convenient trees usually on the banks of the river Rhine, when caravanning I use a very small (ca 50 cm) antenna for 40m made from a Hairspray can, small telescopic aerial (for tuning) and about 80 turns of 2.5mm pvc covered wire on a 50mm plastic drainpipe, the hairspray can also fits into the larger opening of the drainpipe, the instructions and calculator for building this antenna can be found on DL7AHW's website (<http://dl7ahw.bplaced.net/start01E.htm>), I am always amazed at how far I get (to date 3 QSO's over 900 Kms distance) using The Fivehead with 1.5 watts and this hairspray can antenna, I have also built one for 80m using a 3 hairspray cans soldered one on top of the other (please go to G1ZOS at QRZ.COM for pictures) with some success but not as good as the 40m version.

Another portable antenna that I have had a lot of success with is a short dipole resonant for 40m from an idea by G3TKN, the complete antenna with open wire feeder is made from 2 x 11.20m lengths of wire, the dipole are 2 x 8.23m and the open wire feeder is 2.44m with a 5 cm spacing, see this website for details (<http://www.dg9sr.co.cc/antennenbau.html>) please go to G1ZOS at QRZ.COM for pictures of this antenna. I also use another $\frac{1}{2}$ wave dipole at the moment for portable ops, this one I made for 80m with switches which are two large chocolate blocks on each dipole, cut the wire for the 40m band and put one block each side of the cut but leaving a length of flying lead (about 4cm) on the 80m band wire, use an off cut from a cable tie to join the blocks together with a gap of about 3cm, I also have some cord hanging down from the blocks, I lower the middle of the antenna pull down on the cords and then its an easy matter armed with a screw driver to change bands from 40 to 80m by inserting the flying lead into the 80m wire block, I have also built G4ILO Julian Moss's Wonder Loop, this has a diameter of 80cm and works well on 40m. I am always on the lookout for new antenna ideas either for portable QRP ops, small garden or my "L" shaped attic at home. Vy 73 de Colin DD5CF/G1ZOS

Minster Mk 3 Advice please!

The basic rig is likely to be an any single band 20 - 80m 5W CW and SSB TCVR costing about £100 built on two 100 x 160 mm PCBs with a strong mixer etc - see the next page! I plan an 'RF Extras' kit that will provide at least two extra bands anywhere between 10 to 160m (but probably not 12m due to the need for special crystals!) so making it into at least a 3 band rig. The extras include the RF BPFs and TX LPFs plus VFO/LO mixer using a PPL. This kit could probably also include AGC and a resistive antenna matching bridge. The RF Extras kit is likely to cost roughly £65; however, the scheme could be easily extended to provide 5 extra bands so making the whole rig into an any 6 band rig, probably needing two extra PCBs and costing towards £90 so making the 6 band phone and CW rig cost towards £230 with a counter! This strikes me as too much. I would welcome any comments from potential builders as to how many additional bands I ought to aim for in the RF Extras kit and the facilities they consider important. At the moment I am not sure if it would be feasible to say add two bands and then have a second band pair if builders felt wealthy! Comments please! Tim G3PCJ

Commutating Mixers

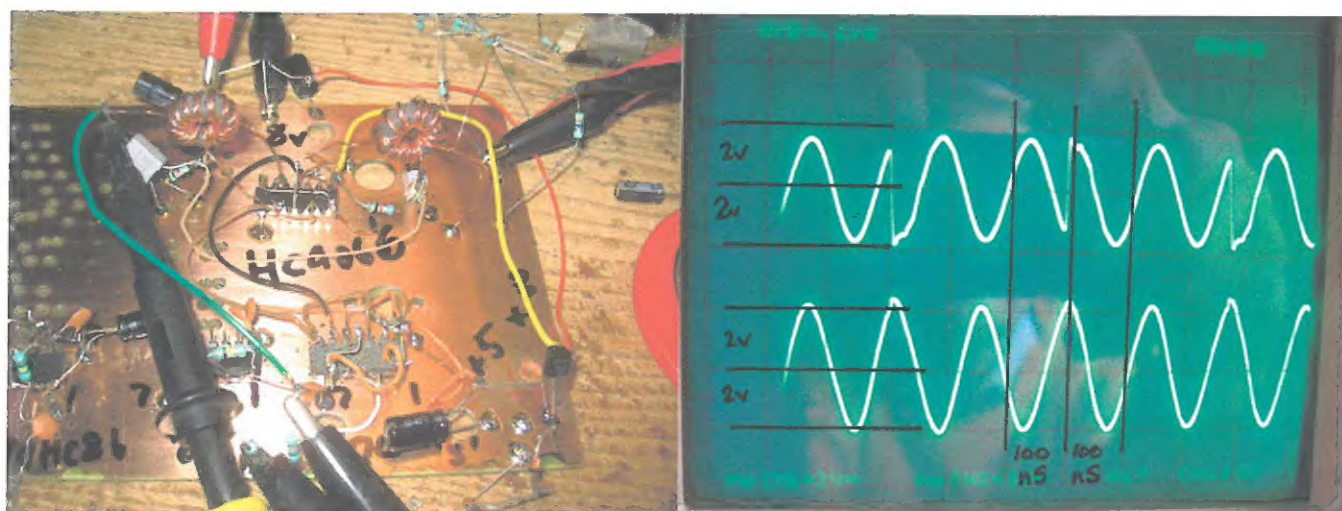
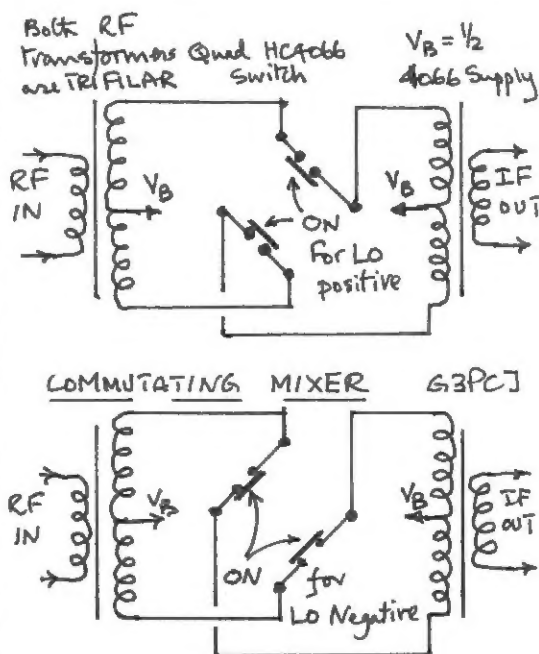
I make no apology for droning on about mixers! They are key to the superior performance of any receiver on our crowded bands where there is such a huge range of signals levels in adjacent channels. Conditions on 40m are the classic example although they are not quite so bad as they used to be now that the commercial broadcasters are moving elsewhere.

Although I well appreciate the advantages of the doubly balanced quad diode mixer, I have never felt entirely comfortable with it when I have attempted home built (and hence lower cost) alternatives. Nothing wrong with the doubly balanced configuration which prevents feed-through between ports - it's the diodes and their required driving power that has made me uncomfortable. If you look back over last decade or more, several workers have used 'electronic switches' instead of diodes. This set me thinking about using MOSFETs but their high gate capacity is a problem and is one reason why the H mode configuration was developed; in this arrangement the switching action is between a signal 'line' and ground so that unwelcome gate capacitance does not affect the signal path. The drawback is that it needs some nasty looking RF transformers!

The action of all these commuting mixers (diode, FET, etc) is really very easy to follow! On alternate half cycles of the LO signal, the output is either the same as the RF input or its polarity is inverted. In effect the RF signal is multiplied by + or - 1 at the LO frequency. This is most easily seen in the two diagrams right for alternate LO half cycles. The mathematics of this switching give rise to a mixer output with sum and difference frequencies of the RF and LO (plus other lesser higher order products). The advantage of the FET approach is that potential large signal handling is better without there being any significant linearity drawbacks.

The FETs act as plain switches alternatively linking input to output, so it would appear that the 4066 style of electronic switches that I already use for mixer control in superhets might be suitable. These are available as quad ON-OFF switches and their control by plain logic signals makes them easy to drive without any high power LO stage - but they do need both polarities of LO drive! It is better to use the 74HC4066 device in a 50R system because it has an ON resistance of less than 30R instead of about 80R for the CD4066.

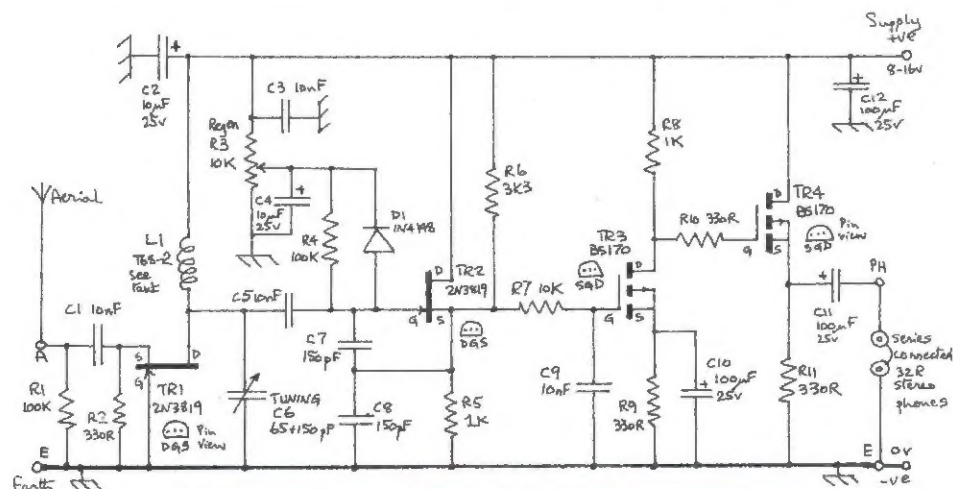
The HC version can also take up to 9 volts supply which enhances max signal handling. The scope picture shows a sine wave input (lower trace) having its phase reversed (output - top trace) at the LO frequency; in this test set-up, the LO is at exactly one quarter of the RF signal in order to obtain a steady picture! 2v/div vertical and 100 nS/div horizontal. Looks promising for the Minster! Tim



The Littleton

This is relatively simple Regen TRF receiver which most builders ought to be able to make in an afternoon! It is about the simplest RX you can make which is legal (ie does not radiate) and is able to drive the modern style of stereo 32R phones. The Regen TRF approach can copy ordinary amplitude modulation (which is still used by many short wave broadcasters), or amateur CW and SSB signals. The RX uses just four field effect transistors – two JFETs and two MOSFETs. Signals from your antenna first enter a grounded base JFET stage using a 2N3819 whose purpose is to prevent radiation when the Regen stage is oscillating; it also provides an impedance step up to the resonant circuit which defines the frequency the RX is tuned to. The second stage uses another JFET as a regenerative detector whose bias can be adjusted to make it oscillate (or not) depending on the type of signal being sought. Because a JFET would normally always oscillate in this configuration, the source is connected to a voltage divider whose positive level normally cuts off the device - only when the gate bias is increased by the Regen pot will the device become active and then able to oscillate. Sensitivity and selectivity are best for AM just below the point of oscillation, and just above it is best for CW and SSB – the pot allows easy adjustment of this critical point. The second 2N3819 also acts an infinite impedance detector. The two audio stages are also biased from the detector via a simple filter to remove the worst of any RF! The first BS170 MOSFET provides the audio voltage gain while the second is a buffer to provide the extra current required when driving the series connected earpieces of 32R stereo phones.

The circuit is so simple that you can build it 'dead bug' style on a plain sheet of un-etched copper clad PCB material. With reasonably short earthy leads, the circuit will be self supporting and quite rigid enough for casual use. Take care when mounting the phones socket to ensure that the common sleeve contact is NOT connected to 0 volts. The PolyVaricon tuning capacitor can be mounted upside down and secured by a wire strap (after applying tape to insulate the bolt heads!). The circuit includes a couple of parts (R1 and C3) whose role is only to act as mechanical anchors! The tuning 'band' is set by the value of the single inductor L1 – suggest start with 35 turns on the T68-2 for about 3 to 6 MHz, or down to 14 turns for about 8 to 16 MHz. The tuning range is determined by the size of C6. Plenty of scope for experiment here! I have a few basic kits (including all parts but no etched PCB) for £17 or post paid for a £20 note. Good luck! Tim G3PCJ



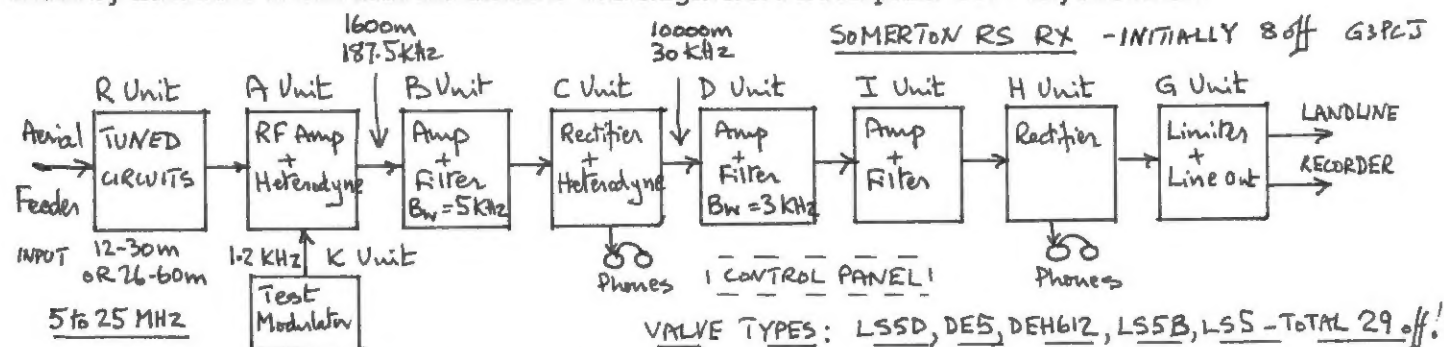
THE LITTLETON
REGEN TRF RX



Snippets!

Somerton Radio Station

I have just been given a description of the RXs at this Marconi beam RS. In modern parlance they are double conversion superhets but it is not clear what form of modulation was used. By inference it was tone modulated - but might have been plain CW - anyone know?



CW Keyers etc

Peter Thornton passes on some interesting links about keyers:-

- The "Morse Machine": www.i2rtf.com/html/cw_machine.html which does a phenomenal job but it's way, way 'OTT' for me;
- KD1JV: http://kd1jv.qrpradio.com/Butterfly_keyer.HTM which has a text readout;
- KD1JV: <http://kd1jv.qrpradio.com/skc/SKC.HTM> which is a keyer chip with a unique mute output, very useful;
- PicoKeyer: http://www.hamgadgets.com/index.php?main_page=product_info&products_id=28 a straight keyer chip, with useful message memories.

HF Transceiver 'chips'

A recent note in Electronics weekly highlights a new transceiver device that can deliver a data rate of 7 Gigabits/sec over an RF link at 60 GHz! That is High Frequency!

QRP in the Country 2012 - July 15th 2012

I hope that most Construction Club members in the south west, and maybe from further off, have already made your plans to visit here for our third QRP in the Country event. Plenty of space is still available for individuals or Club to have a stall and put on a display of some sort or sell off unwanted radio items etc. If you want a stall please let me know before hand. No charges for entry or for stalls! If anybody coming from afar would like help with accommodation overnight let me know. Loads of things to see etc and I am already aware of some entries for my informal **Construction Challenge** that Steve Hartley has kindly agreed to judge! The task is to build a receiver for any MF or HF amateur band using no more than 10 discrete components and if you wish to, also one integrated circuit and one supply regulator. Your choice of types! In addition there will be many Club and individual stalls with of course some local food and drink. I hope to have the G3GC Plank running with an AR88 this year to make reception slightly easier, and there will also be other wartime radio gear on display!! Rob Mannion G3XFD Editor of PW, the RSGB and other QRP personalities will be here! Richard Booth has promised to come down and assist those needing a little technical advice and of course there will be the latest kits from you know who! Gates open 10 am; undercover if the WX is poor! Farm tours by my wife Janet if anybody would like them!



Subscriptions!

I regret it is that time of year again! The next issue of Hot Iron is the first of the membership year and I need to receive your payment of £8 for UK members by Sept 1 2012. Overseas membership costs £10. Sorry about the price rise but blame the Post Office! If you wish to pay via Paypal this is fine, but please add an extra £1 for their fee. All I need is your fee and name/address. To keep it interesting your contributions are essential! Any article about your experiences, questions, hints and tips etc. are especially welcome. Hope to see you July 15th! Tim G3PCJ